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ABSTRACT

Developed by the ABCs of Construction National Workplace Literacy Project, these curriculum materials for the area of electrical and instrumentation contain a lesson that deals with reading diagrams. The lesson consists of an objective, instruction, and 10 exercises. The objective for the lesson is for the student to learn to locate and apply information from a diagram. (YLB)

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ED 374 290

TECHNICAL DEVELOPMENT CENTER

Reading Diagrams

E & I

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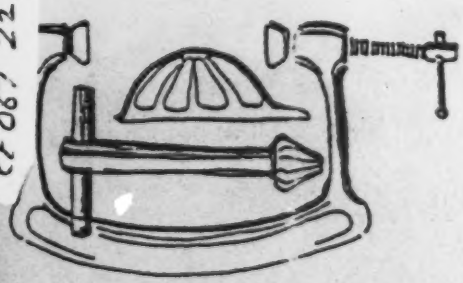

Associated Builders & Contractors, Inc.
EBR Adult & Continuing Education

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ABC's of Construction

National Demonstration Project in Workforce Literacy

The ABC's of Construction Project was funded in 1991 by the U.S. Department of Education as a grantee through the National Workplace Literacy Program (PR #198A10155). The program provided basic skills instruction to industrial construction workers employed by companies which are members of the Pelican Chapter of Associated Builders and Contractors (ABC). Located in Baton Rouge, Louisiana, ABC provides training to employees of over 60 member companies who perform contract work in the 58 petrochemical facilities located along the Mississippi River between Baton Rouge and New Orleans.

The grantee, the Adult Education Department of East Baton Rouge School Board, performed a comprehensive literacy task analysis of the apprenticeship training program for millwrights, pipefitters, electricians, instrumentation techs, and welders involved in the ABC training program. Over 20 modules of original, contextual curriculum were developed to teach the reading and math skills required for success in the craft training program.

Materials developed for instruction incorporated cognitive strategies for learning basic skills in the context of the craft and safety knowledge demanded by the industrial construction workplace. Instruction was written for a competency-based, open-entry/open-exit, individualized adult learning program that operated at the ABC training center in the evenings after work-hours.

E & I

READING DIAGRAMS

OBJECTIVE

You will learn to locate and apply information from a diagram.

INSTRUCTION

A construction site appears confusing to the average person. Workers do a variety of jobs which seem to be unconnected. How do they know what to do? How does everything finally fit together? The answer is in the plans. Plans focus on architectural, structural, mechanical, and electrical views. These working drawings tell how the job is done by showing, or diagramming, what to do. A diagram, then, is a drawing of a product or process.

Diagrams have many uses. They often show complex concepts. They can also show simple details. They can show a reduced version of something large. They can show an enlarged version of something very small. They help you picture processes, structures, relationships, or details. In all cases, diagrams help you visualize. You use diagrams on the job. You also find diagrams in E & I coursework. All diagrams have a main idea or purpose. The diagram's title helps you determine main idea. Diagrams also have details. Labels show you which details require your attention. Your job is to decide how the details relate to each other and to the main idea.

Text descriptions often accompany diagrams. These serve varied functions. They can identify the main idea. They can list details. Text descriptions can also tell you things you might not be able to see from the picture. They can tell you how something works. They can explain specific features. They can describe processes and relationships. Looking at the description as you look at the diagram increases understanding. You may find diagrams hard to understand after one reading. That's OK. Use both the diagram and the text as references until you understand them.

While diagrams have a purpose, your reason for using them can vary. For example, you might use the preceding diagram to focus on the structure of manufactured buildings. You might also use it to compare service-entrance conductors with service equipment installation.

STEPS IN READING DIAGRAMS

1. **READ THE TITLE.** The title tells you which process, relationship, or item is shown.

2. **EXAMINE ANY LABELS.** Labels focus on important features.

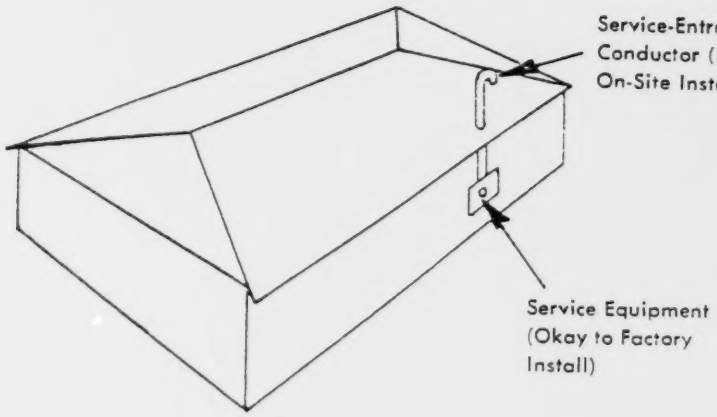
3. **WHAT IS THE PURPOSE OF THE DIAGRAM?** Why does this item or process need to be pictured?

4. **WHAT TEXT INFORMATION ACCOMPANIES THE DIAGRAM?** What describes the diagram? How is it described? What details are included? Why are those details included? How do the text and diagram go together?

5. **WHAT IS THE MAIN IDEA?** How can you describe the diagram? What's important about it? How does knowing this apply to your work?

EXAMPLE

Manufactured buildings not restricted to dwellings; could be Industrial or Commercial.



NEC 545-3 Definition of a Manufactured Building: A manufactured Building is of closed construction, normal factory-made or assembled for installation, or assembly and installation on building site. (Does not include mobile home or recreational vehicles.)

NEC 545-6 Service-Entrance conductors to be installed at building site, except where point of attachment is known before manufactured.

1. READ THE TITLE. The title is "Manufactured buildings not restricted to dwellings; could be Industrial or Commercial."

2. EXAMINE ANY LABELS. The following labels are shown: "Service-Entrance Conductor (Normally On-Site Installation)" and "Service Equipment (Okay to Factory Install).

3. WHAT IS THE PURPOSE OF THE DIAGRAM? The purpose is to show how manufactured buildings look and to show examples of service-entrance construction and service equipment installation.

4. WHAT TEXT INFORMATION ACCOMPANIES THE DIAGRAM? The text describes NEC definitions and requirements.

5. WHAT IS THE MAIN IDEA? The main idea is that manufactured buildings are constructed in specific ways and have a variety of uses.

EXERCISE 1

Jake is installing steel-duct outlet fittings in steel-duct-raceway systems. He uses a method based on the following from the AMERICAN ELECTRICIAN'S HANDBOOK:

234. Installation of outlet fittings in steel-duct-raceway systems. When a duct outlet is to be used for service, the small amount of concrete is removed from the top depression of the outlet plug. The plug is removed by unscrewing it from the duct with a plug-removal wrench. The removal of the plug forms a neat preformed passage through the concrete to the duct-outlet opening. The necessary wires are pulled in from the nearest junction box and threaded through the service fitting. The service fitting is then screwed into the duct-outlet opening, and the floor flange adjusted. When it is desired to locate an outlet at a point in a raceway where there is no preset insert plug, an afterset insert for the outlet can be made by the use of special tools available from the manufacturer. The method of making an afterset insert is illustrated in Figure 9-149. .

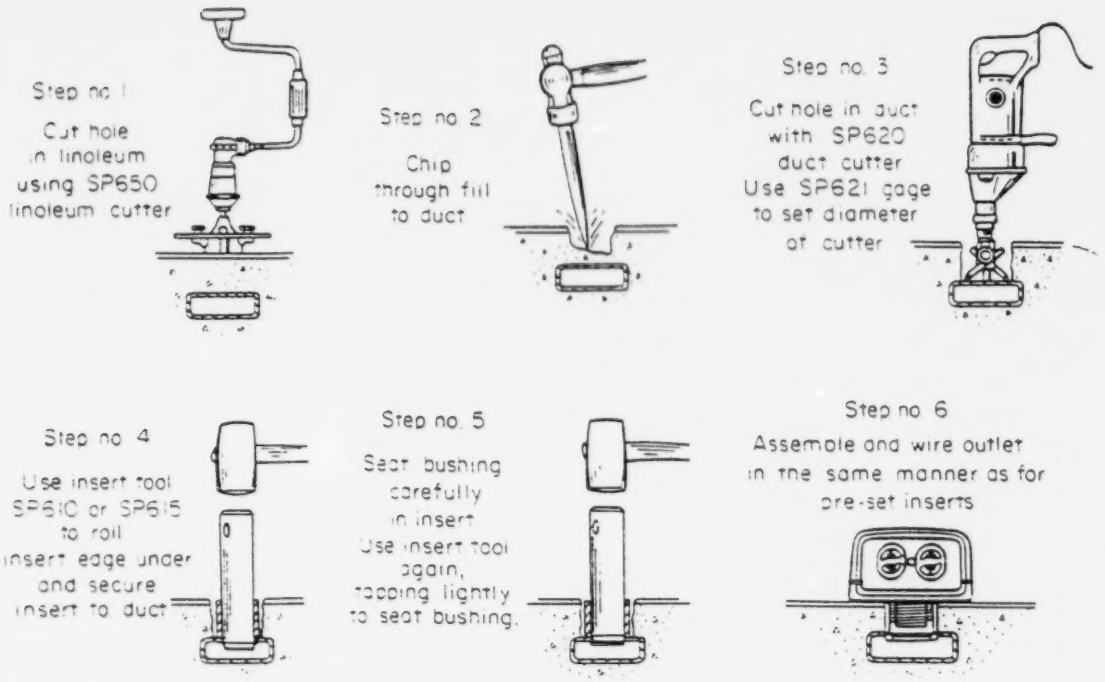

Step no 1
Cut hole in linoleum using SP650 linoleum cutter
Step no 2
Chip through fill to duct
Step no. 3
Cut hole in duct with SP620 duct cutter Use SP621 gage to set diameter of cutter
Step no 4
Use insert tool SP610 or SP615 to roll insert edge under and secure insert to duct
Step no. 5
Seat bushing carefully in insert Use insert tool again, tapping lightly to seat bushing.
Step no 6
Assemble and wire outlet in the same manner as for pre-set inserts

Fig. 9-149 Method of making an outlet with an afterset insert. [General Electric Co.]

1. Jake must remove a plug from a duct. What tool should he use?

   A. cold chisel
   B. phillips screwdriver
   C. plug removal wrench
   D. electric drill with a router bit

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

2. Jake asks his helper for a SP650. What is a SP650?
   A. the duct size
   B. the outlet assembly
   C. an insert tool
   D. a linoleum cutter

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

3. Jake just secured the insert to the duct. What should he do next?

   A. chip through the fill
   B. cut a hole
   C. seat the bushing
   D. wire the outlet

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

4. Jake tells his helper to cut a hole in the duct. What tool should he use?

   A. SP620
   B. SP615
   C. SP650
   D. SP610

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

5. What is another word for fill?

   A. wiring
   B. dirt
   C. linoleum
   D. concrete

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

EXERCISE 2

EZ Construction Company won the bid for installing underfloor raceways. Workers use the following plan for ductwork details:

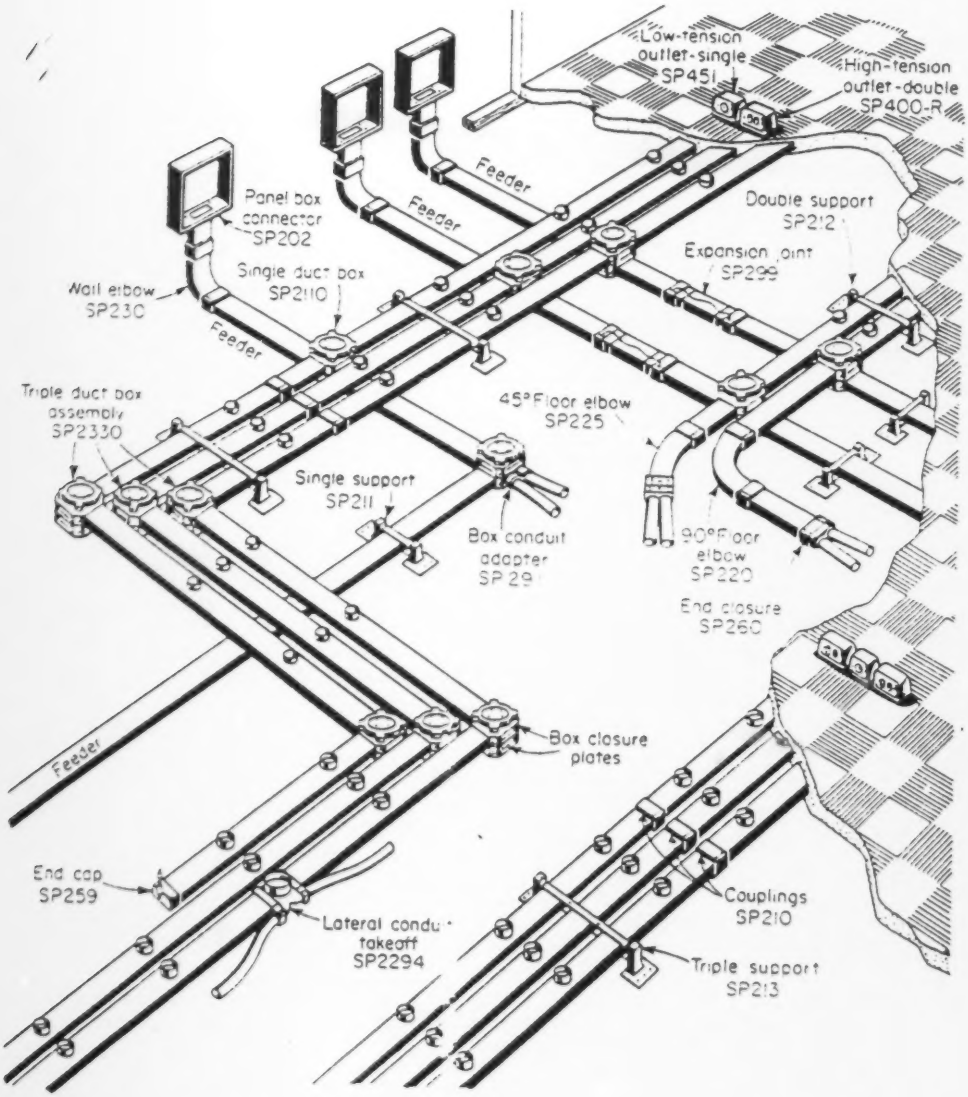


Fig. 9-138 Component parts and method of installation for two-level steel underfloor raceways. [General Electric Co.]

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As a joke, someone mixed up the parts. Match each part number to its label.

A. SP259	1. Box conduit adapter
B. SP212	2. Couplings
C. SP260	3. Triple support
D. SP230	4. Double support
E. SP291	5. End closure
F. SP213	6. End cap
G. SP451	7. Expansion joint
H. SP2330	8. Low-tension outlet--single
I. SP210	9. Triple duct box assembly
J. SP299	10.Wall elbow

(a) Are the answers to these questions found on the diagram?

(b) How did you know?

EXERCISE 3

Amy's crew used the following diagram to install a wiring system. Her supervisor is checking their work. Put "OK" by the items which are correct. Put an "X" by those which are wrong.

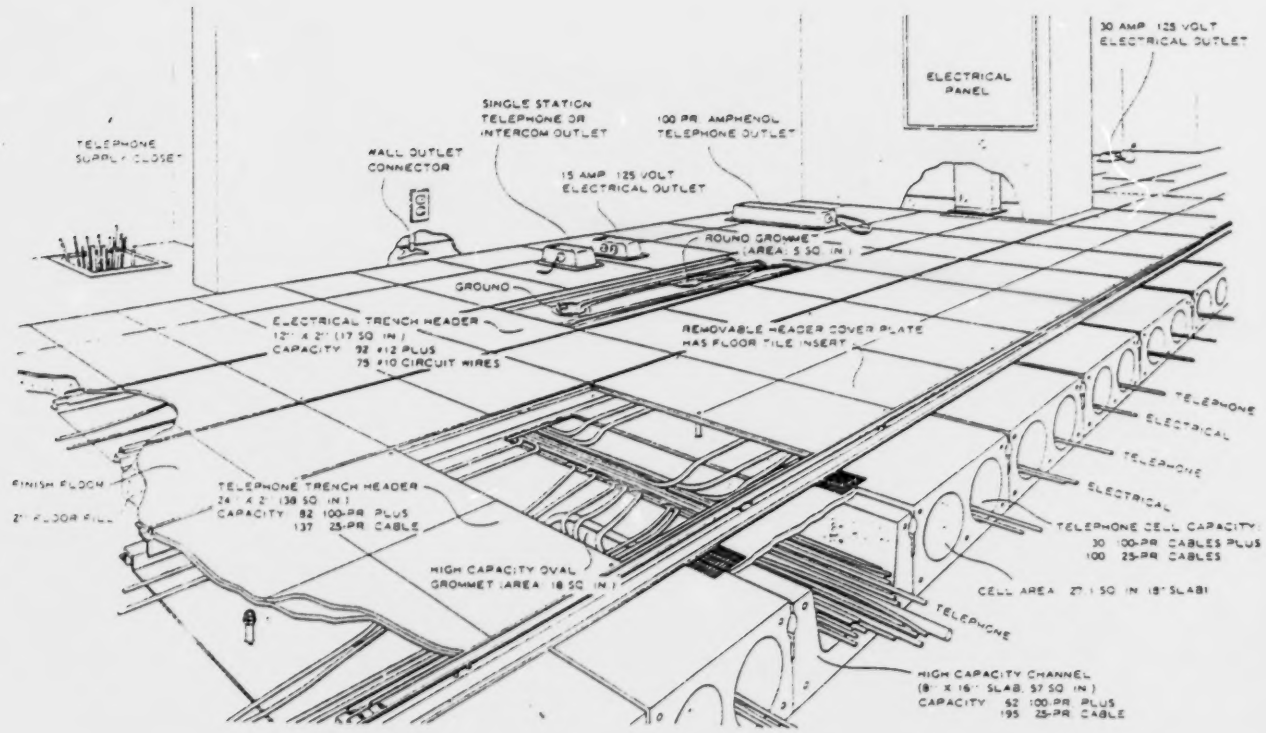

Fig. 9-21A High-capacity system with trench header ducts. [The Flexmore Co., Inc.]

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_____ 1. Floor fill equals 3 inches.

_____ 2. All electrical outlets are 15 amp, 125 volt.

_____ 3. Round grommets have an area of 5 square inches.

_____ 4. Telephone outlet has 100 pr. amphenol.

_____ 5. High capacity oval grommets have area of 8 square inches.

_____ 6. Telephone cell capacity is a total of 130 cables.

_____ 7. The electrical trench header is 12" by 3".

_____ 8. The slab in the high capacity channel is 8" by 16".

_____ 9. The telephone trench header holds 137 25 pr. cables.

_____ 10. An intercom outlet is installed next to a 30 amp, 125-volt electrical outlet.

(a) Are the answers to these questions found on the diagram?

(b) How did you know?

(c) Identify the information you used to answer these questions.

EXERCISE 4

Hans is learning field sketching. He uses the following information to lay out a right angle:

98. **Laying out a right-angle conduit bend.** Draw a chalk-line diagram of the contour of the bend on the floor as follows (See Fig. 9-49): Draw a base line CO of any length. Lay off AO 4 units long. (The units may be of any dimensions). With a cord and a piece of chalk with O as a center and a radius of 3 units describe the arc IJ. With A as a center and a radius of 5 units describe the arc EH. The line OD drawn from O through B, the intersection of two arcs, will be at right angles with CO. CO and OD can now be prolonged for any distance. The arc CD is drawn with the cord and chalk with any required radius R. The conduit bend should lie parallel to this arc when the bend is laid on the floor for inspection.

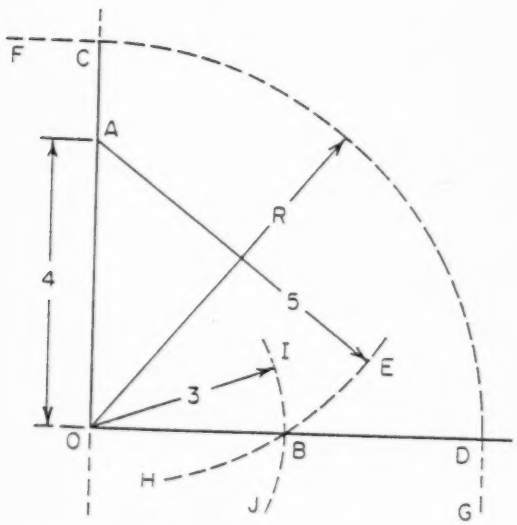

Fig. 9-49 Laying out a right angle.

1. Which line is perpendicular to line AO?

A. CO

B. RO

C. IO

D. BO

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

2. Which line intersects line AE?

A. BD

B. OR

C. HE

D. OA

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

3. Which of the following is not at arc?

A. HE

B. OI

C. GF

D. JI

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

4. What point marks the intersection of OD and HE?

A. B

B. I

C. J

D. G

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

5. What is the length of line BD?

A. 5 units

B. 4 units

C. 3 units

D. You cannot tell from the diagram or text.

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

EXERCISE 5

Lou's crew installs self-supporting poles. Their work should look like the diagram below.

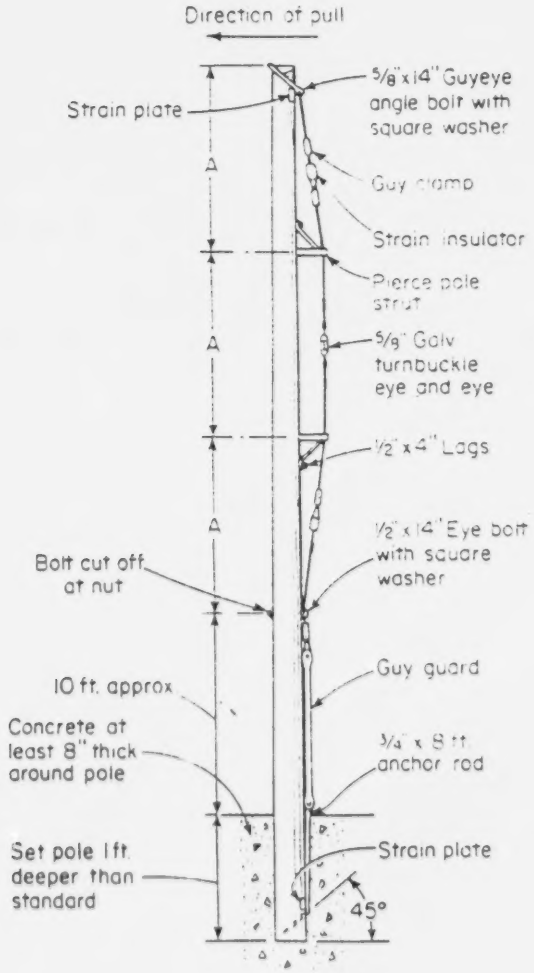
Direction of pull
5/8" x 14" Guyeye angle bolt with square washer
Strain plate
Guy clamp
Strain insulator
Pierce pole strut
5/8" Galv turnbuckle eye and eye
1/2" x 4" Lags
1/2" x 14" Eye bolt with square washer
Bolt cut off at nut
Guy guard
10 ft. approx
Concrete at least 8" thick around pole
3/4" x 8 ft. anchor rod
Strain plate
Set pole 1 ft. deeper than standard
45°

Fig. 8-91 Details of self-supporting pole.

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You are the supervisor. To approve their work, place "OK" in the blank. If the work is wrong, place an "X" in the blank.

_____ 1. The crew used 6 inches of concrete to set the pole.

_____ 2. The pole was set 12 inches deeper than standard.

_____ 3. The direction of pull is on the opposite side of the location of the guy guard.

_____ 4. The crew used a 5/8 X 14 inch Gueyete angle bolt with a round washer.

_____ 5. A guy clamp was installed below the strain insulator.

_____ 6. The crew installed a total of 2 strain plates.

_____ 7. The anchor rod was 3/4 x 8 inches.

_____ 8. The crew used a 5/8" stainless steel turn bucket eye and eye.

_____ 9. The size of the lags was 1/2 x 4"

_____ 10. The size of the eye bolt was 1/2" X 14"

(a) Are the answers to these questions found on the diagram?

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the questions .

_____

_____

EXERCISE 6

Jess installs SNAP CAP raceways. He is ordering parts to install surface raceway and fittings. He looks at the diagram below. Place a check beside the items he needs to order.

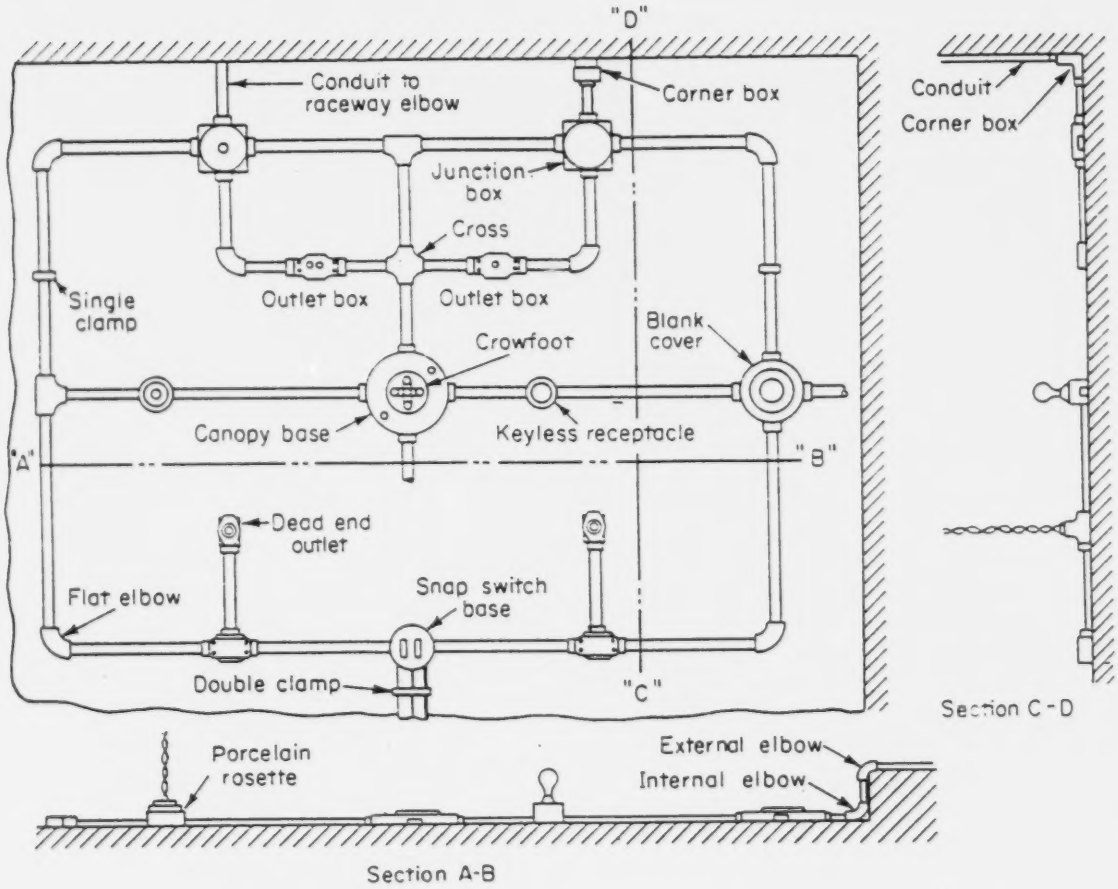

Fig. 9-90 Application of surface raceway and fittings.

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_____ 1. conductors

_____ 2. flat elbow

_____ 3. guy clamp

_____ 4. eye bolt

_____ 5. cross

_____ 6. crowfoot

_____ 7. outlet box

_____ 8. anchor

_____ 9. insulator

_____ 10. cornerbox

_____ 11. blank cover

_____ 12. square washer

_____ 13. limit switch

_____ 14. internal elbow

_____ 15. ac supply

_____ 16. dead end outlet

_____ 17. stainless steel rosette

_____ 18. floor elbow

_____ 19. vertical elbow

_____ 20. canopy base

_____ 21. junction box

_____ 22. double clamp

_____ 23. single clamp

_____ 24. trench duct

_____ 25. baseboard cap

(a) Are the answers to these question found on the diagram?

(b) How did you know?

(c) Identify the information you used to answer the questions

EXERCISE 7

Lee is installing cellular-concrete floor raceway. The following diagram is his blueprint:

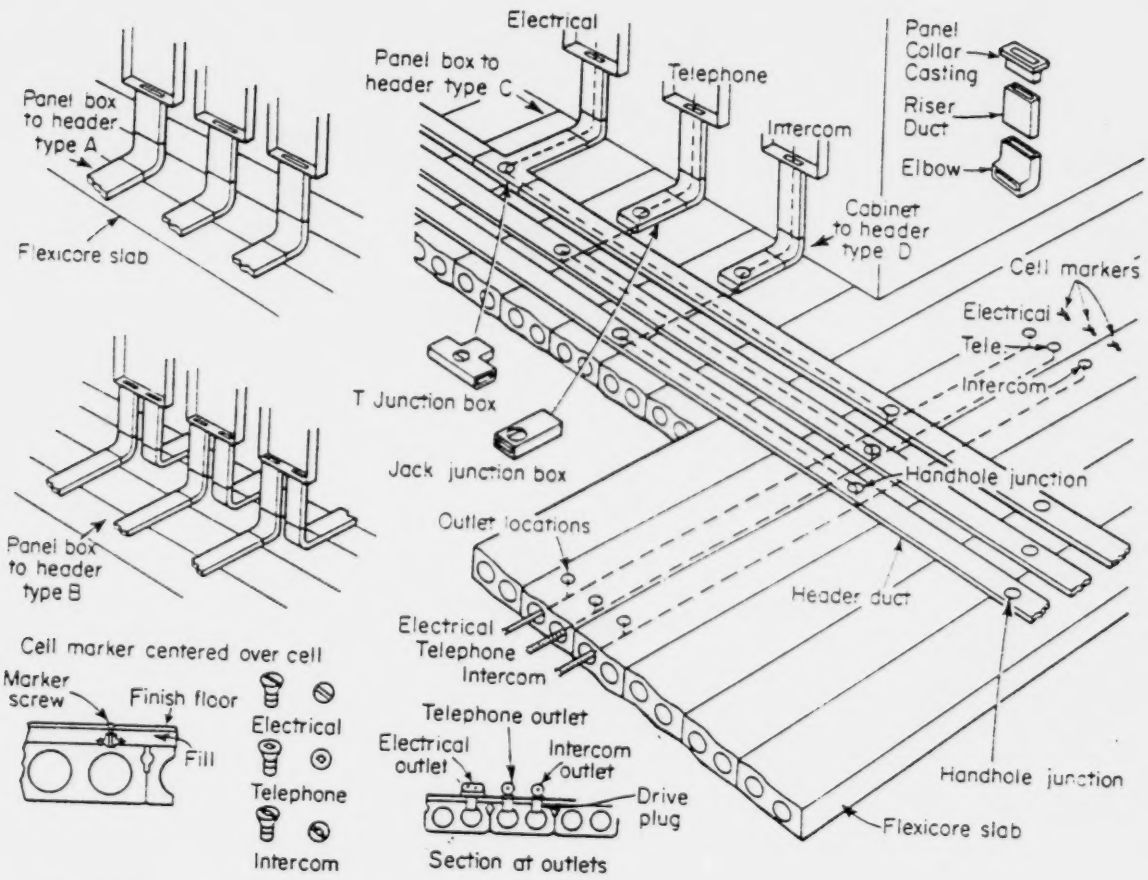


Fig. 9-210 Details of installation of a cellular-concrete-floor raceway. (The Flexicore Co., Inc.)

1. What kind of junction box does Lee need for electrical lines?

A. jack junction box
B. T junction box
C. outlet junction box
D. handhole junction box

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

2. How many header types are shown in the diagram?

A. 3
B. 4
C. 5
D. 6

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

3. Other than electrical wires, what other kinds of wire will Lee run?

A. telephone and intercom
B. high voltage and computer
C. AC and DC
D. Lee doesn't need to run any other kinds of wire.

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

4. What is used to mark a cell?

A. drive plug

B. colored marks

C. stenciled numbers

D. screw

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

5. What connects an elbow to a panel collar casting?

A. header duct

B. flexicore slab

C. riser duct

D. panel box

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

EXERCISE 8

Chuck installs cellular-concrete-floor raceways. His supervisor gives him the following plan:

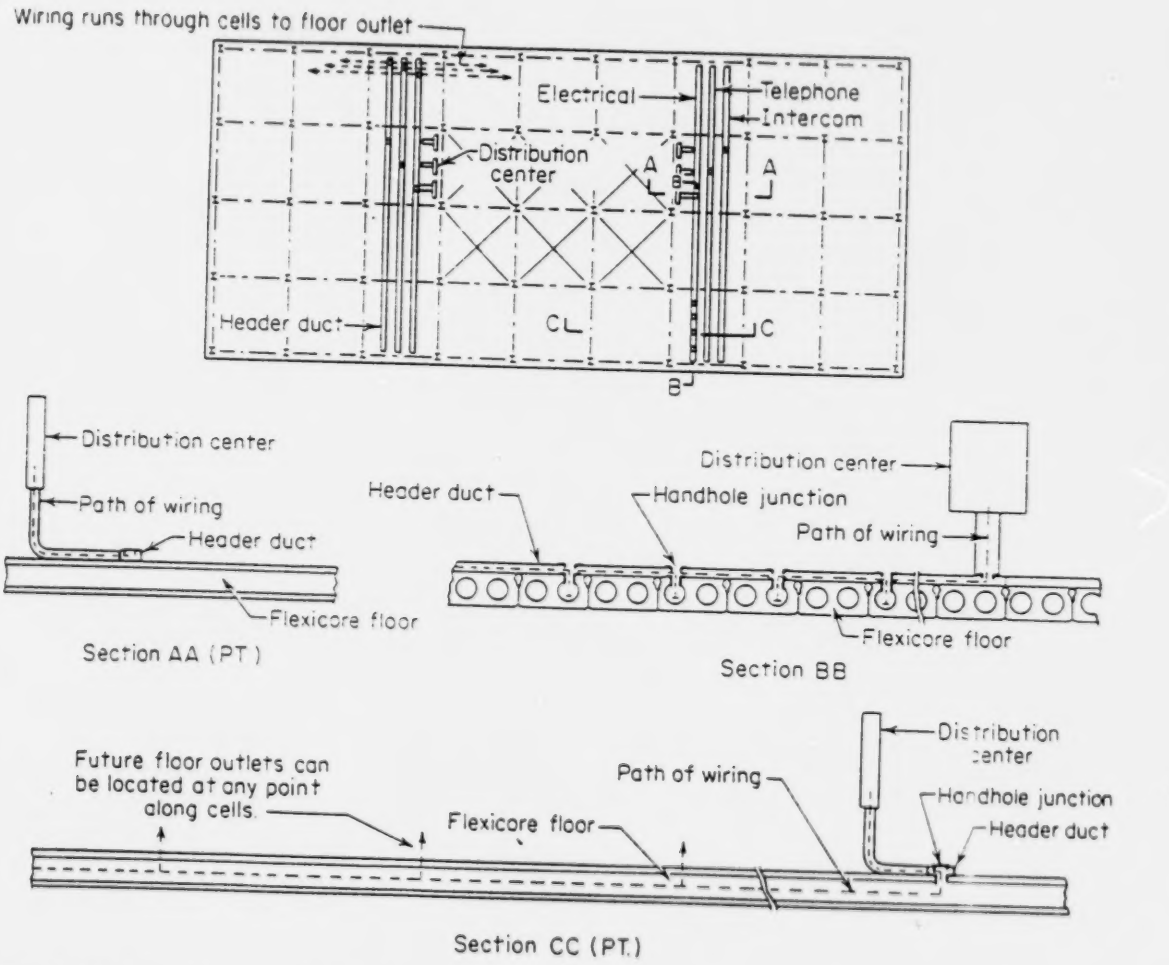


Fig. 9-206 General principles of electrical distribution by means of cellular-concrete-floor raceways. [The Flexicore Co., Inc.]

1. How many cells are shown in the diagram?

_____

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

2. What does Section BB show?

_____

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

3. Which is larger, section AA or section BB?

_____

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

4. What two sections are parallel?

_____

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

5. What are 2 other kinds of wiring shown in the diagram?

_____

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

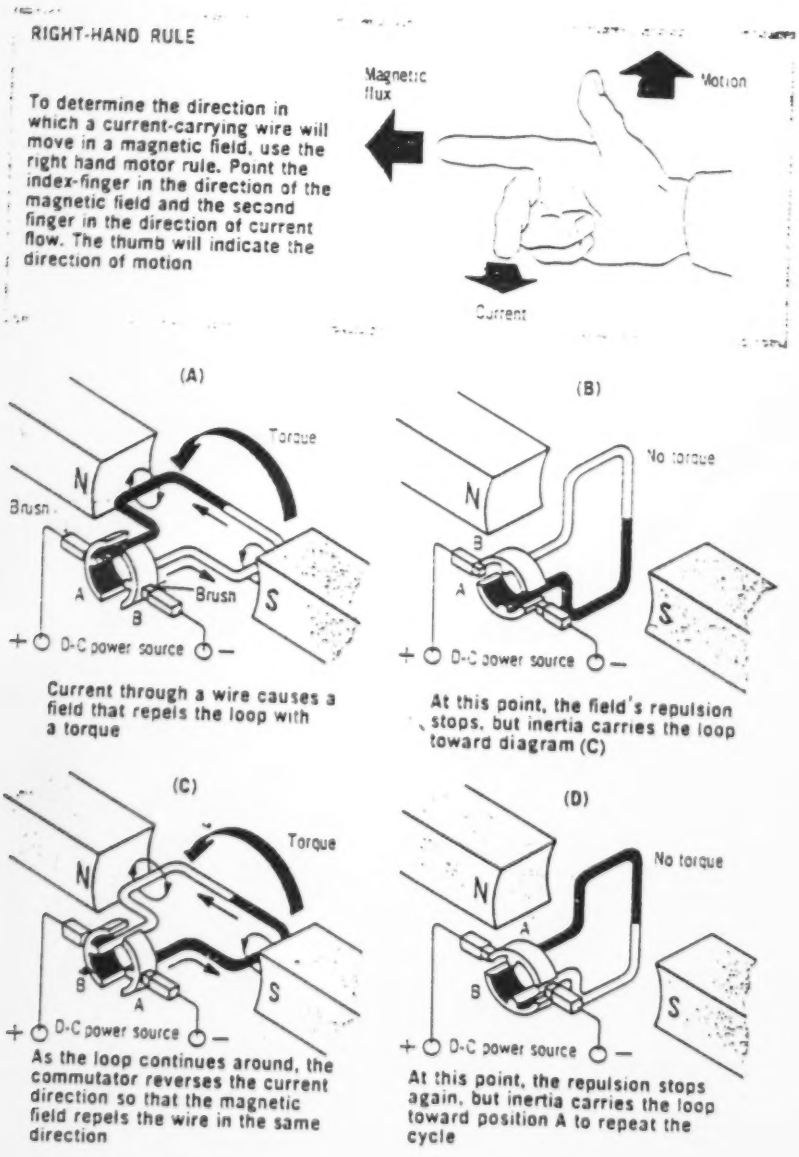
_____

_____

EXERCISE 9

Any installs electric motors. He is showing a new co-worker how motors work. He uses the following diagram to explain:

the electric motor


RIGHT-HAND RULE
To determine the direction in which a current-carrying wire will move in a magnetic field, use the right hand motor rule. Point the index-finger in the direction of the magnetic field and the second finger in the direction of current flow. The thumb will indicate the direction of motion
Magnetic flux
Motion
Current
(A)
Torque
N
Brush
A
B
Brush
S
D-C power source
Current through a wire causes a field that repels the loop with a torque
(B)
No torque
N
B
A
S
D-C power source
At this point, the field's repulsion stops, but inertia carries the loop toward diagram (C)
(C)
Torque
N
B
A
S
D-C power source
As the loop continues around, the commutator reverses the current direction so that the magnetic field repels the wire in the same direction
(D)
No torque
N
A
B
S
D-C power source
At this point, the repulsion stops again, but inertia carries the loop toward position A to repeat the cycle

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1. What is the power source?

_____

_____

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

2. What is "N" and "S?"

_____

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

3. In what direction, does the loop first turn?

_____

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

4. What reverses current direction?

_____

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

5. How does figure B differ from figure D?

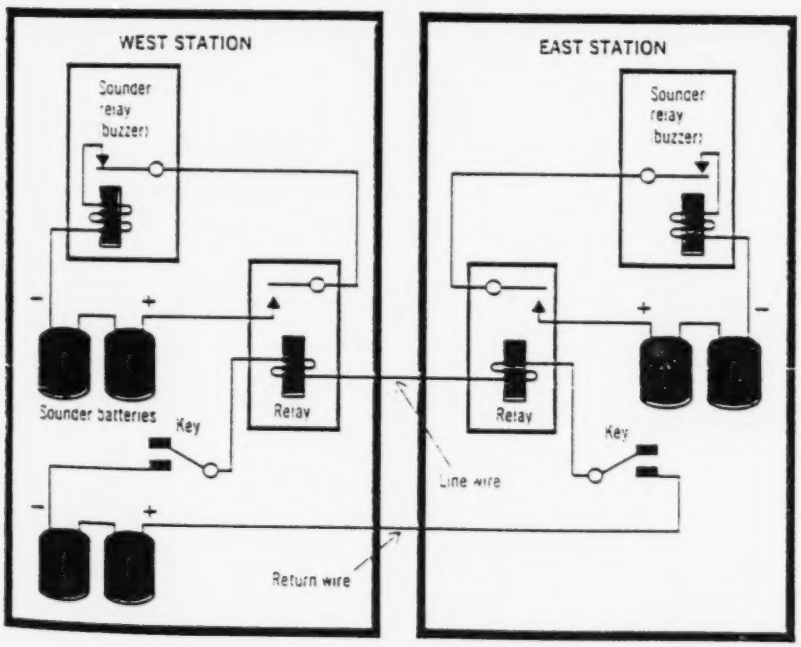
(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

(c) Identify the information you used to answer the question.

EXERCISE 10

Jake is explaining basic telegraph systems to a friend. He sketches the following diagram:



1. What 2 locations are shown?

_____

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

2. How many batteries are used in the diagram?

_____

_____

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

3. How is the West Station different from the East Station?

_____

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

4. What is the total number of relays used in the diagram?

_____

_____

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____

5. What component is placed between the West station key and the East station key?

_____

(a) Is the answer to this question found on the diagram? ____

(b) How did you know?

_____

_____

(c) Identify the information you used to answer the question.

_____

_____